RESEARCH SUMMARY

Jan. 1993 RS–007

forest sciences

NELSON FOREST REGION

The Effect of Plantation Density on the Growth and Yield of White Spruce: 32-Year Results

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- an optimum planting density range of 1300–1600 sph is recommended
- permanent plots will continue to be monitored at 10-year intervals

INTRODUCTION

White spruce (*Picea glauca* (Moench) Voss) is one of the most common tree species planted in British Columbia, yet there are few field studies that measure the influence of initial stand density on subsequent growth (Larocque and Marshall 1988). E.P. 537 is an experimental plantation near Houston, British Columbia. It is the oldest known espacement or planting density study of white spruce in western Canada.

This Research Summary briefly discusses the influence of plantation density on individual stem and stand characteristics, at a total age of 32-years. This information is directly applicable to future plantation yields of 114 million white, hybrid, and Engelmann spruce (*Picea engelmannii* Parry) , planted annually in the province. These species accounted for approximately 52% of all seedlings planted in the Nelson Forest Region in 1991.

PROJECT DESCRIPTION

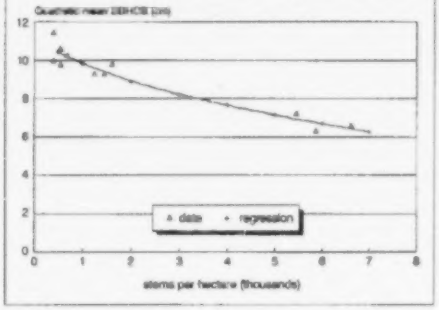
The project was established in the spring of 1959 on a zonal SBSdk site in the Morice Forest District, Prince Rupert Forest Region. Plots were 0.04 ha in area, with permanently tagged trees and a surround of buffer trees. Planting stock consisted of 2+0 bareroot seedlings. Three plots were tested for each of four densities: 420, 747, 1682, and 6727 stems per hectare (sph) .

Initially the heights, and later the diameters, of all trees were measured over the next 30 years. A large number of tree characteristics were measured during the most recent assessments, including: crown diameter, height to lowest live branch, and the diameter of the largest branch in the whorl nearest breast height.

RESULTS

The effects of initial plantation density became apparent at age 17, and continued to increase to age 32. When individual trees were examined, lower densities produced dramatically larger stem diameters, crowns, and branch diameters. Figure 1 displays the effect of plantation density on diameter breast height (dbh). However, when per hectare stand characteristics are compared, the trend is reversed because of the disproportionately greater number of smaller trees. High plantation densities exhibited the largest basal area per hectare and total volume per hectare values (Figure 2).

FIGURE 1: Quadratic mean DBHOB vs. density at age 32.



The two lowest densities used in the trial were judged unacceptable. Individual trees in the 420 and 747 sph range were often of poor form and the stands remained quite open without canopy closure after 32 years. The 6727 sph density was impractically dense. The 1682 sph treatment displayed recent crown closure and full site occupancy at a reasonably early age.

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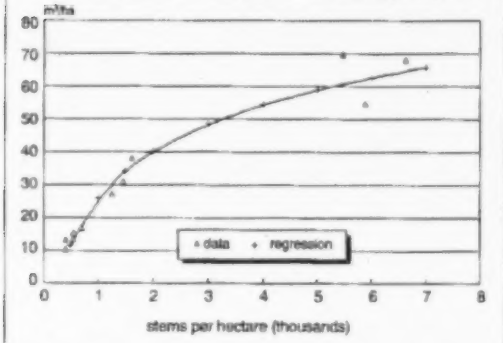
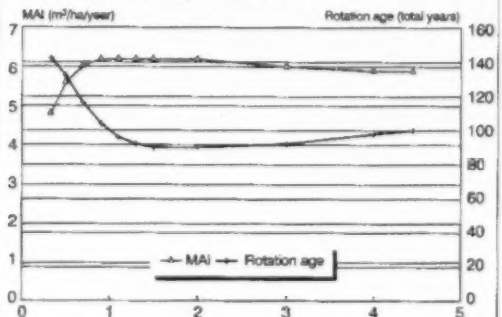
FIGURE 2: Total volume per hectare vs. density at age 32



Mean annual increment (MAI) was estimated at 3.90-4.75 m3/ha per year using the unadjusted Ministry of Forests' yield model for natural stands. The Ministry's managed stand yield model - TIPSY 2.0 Beta - was used to forecast merchantable volume yields (based on a 12.5 cm dbh limit) and rotation ages (Mitchell et al. 1992). The 1682 sph treatment was estimated to produce the highest yield of the four densities tested, at 6.7 m3/ha per year, with a rotation age of 84 years (total age).

These TIPSY MAI values apply to fully stocked stands. When operational, rather than research, plantations are considered, holes created by brush and other factors will reduce yields by approximately 15%.

FIGURE 3. TIPSY 2.0 beta estimates of mai and rotation age for EP 537



The general acceptability of the 1682 sph treatment was tempered with an examination of projected yields using TIPSY 2.0 Beta to determine the relationships between density, merchantable volume yield and rotation age (Figure 3). MAI at rotation age peaked between 1100 - 2000 sph, and rotation age was minimized between 1300 - 2500 sph.

CONCLUSIONS

Of the four treatments tested, the 1682 sph treatment was visibly superior and maximized MAI with the shortest rotation age. However, when TIPSY 2.0 Beta was used to test a range of densities for this site, the MAI and rotation age curves were relatively flat across a range of densities. Combining our observations from these plots with the TIPSY runs, an optimum planting density range of 1300-1600 sph is recommended.

The permanent plots in this study will continue to be monitored on a ten year interval, to aid the development and validation of managed stand yield models.

LITERATURE CITED

Larocque, G. and P.L. Marshall. 1988. *Growth and yield of spruce in the inland mountain west: a literature review.* In Proc. on Future Forests of the Mountain West: A Stand Culture Symp. U.S. Dep. Agric. For. Serv. Tech. Gen. Rep. INT-243, pp 192-196.

Mitchell, K.J., S.E. Grout, R.N. Macdonald and C.A. Watmough. 1992. *User's Guide for TIPSY. A table interpolation program for stand yields.* Version 2.0 Beta. Res. Branch, B.C. Min. For., Victoria, B.C.

For further information, see:

Pollack, J.C., W. Johnstone, K.D. Coates, and P. LePage. *The influence of initial espacement on the growth of a 32-year-old white spruce plantation.* Res. Note No. 111. B.C. Min. For., Victoria, B.C.

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